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EXAMINER	
HAN, SHENG	

ART UNIT	PAPER NUMBER
4162	

NOTIFICATION DATE	DELIVERY MODE
10/07/2008	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/523,070	YAGI ET AL.	
	Examiner	Art Unit	
	SHENG HAN	4162	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 September 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-58* is/are pending in the application.

4a) Of the above claim(s) *9-17,19-22,24-29,36-52,55,56 and 58* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8,18,23,30-35,53,54 and 57* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date *1/27/05*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of Group I, Claims 1-8, 18-23, 30-35, 53, 54 and 57 in the reply filed on 9/11/08 is acknowledged.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claims 1, 2, 8, 18, 23 and 54 are rejected under 35 U.S.C. 102(a) as being unpatentable over Schuppich (7247276). Schuppich teaches a microreactor for capable obtaining hydrogen gas (col. 8, lines 10-11) comprising a metal substrate (col. 10, line 53, nickel-copper alloy) having a microchannel portion on one surface thereof (Fig. 1, 1), a heater provided on the other surface of the metal substrate (col. 5, lines 57-58, fluid guidance plate can be cooled or heated on its rear side), via an insulating film (Fig. 2, 23), a catalyst supported on said microchannel portion (col. 7, line 5-7, catalyst is applied by coating), and a cover member (Fig. 2, 12 and col. 3, line 53, top plate) having a feed material inlet (col. 5, lines 60-64) and a gas outlet (col. 5, line 64). Schuppich teaches that the cover member having a feed material inlet (Fig 3, inlet) and

a gas outlet (Fig. 3, outlet) are joined to the metal substrate so as to cover the microchannel portion.

Regarding Claim 2, Schuppich teaches use of a nickel-copper alloy (col. 10, line 53).

Regarding Claim 8, please refer to the rejection for Claim 1.

Regarding Claim 18, Schuppich teaches a flow path (Fig. 1, 1) and Schuppich teaches that the catalyst is supported on the whole inner surface of the flow path (col. 7, line 5-7, catalyst is applied by coating).

Regarding Claim 23, Schuppich teaches a metal substrate (col. 10, line 53) is provided with a heater on a surface opposite to the surface where said microchannels portion is formed (col. 5, lines 57-58, fluid guidance plate can be cooled or heated on its rear side), via an insulating film (Fig. 2, 23).

Regarding Claim 54, please refer to the rejection for Claim 1.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 3, 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Schuppich (7247276), as applied to Claim 1, and further in view of Thies (6736983). Schuppich teaches a microreactor capable of obtaining hydrogen gas (col. 8, lines 10-11) comprising a metal substrate (col. 10, line 53, nickel-copper alloy) having a microchannel portion on one surface thereof (Fig. 1, 1), a heater provided on the other surface of the metal substrate (col. 5, lines 57-58, fluid guidance plate can be cooled or heated on its rear side), via an insulating film (Fig. 2, 23), a catalyst supported on said microchannel portion (col. 7, line 5-7, catalyst is applied by coating), and a cover member (Fig. 2, 12 and col. 3, line 53, top plate) having a feed material inlet (col. 5, lines 60-64) and a gas outlet (col. 5, line 64). Schuppich teaches that the cover member having a feed material inlet (Fig 3, inlet) and a gas outlet (Fig. 3, outlet) are joined to the metal substrate so as to cover the microchannel portion. Schuppich does not teach that the insulating film is a metal oxide film formed by anodically oxidizing said metal substrate or the use of an Aluminum substrate however. Schuppich teaches use of a nickel copper alloy (col. 10, line 53). Thies teaches a microreactor for obtaining hydrogen gas (col. 1, line 8) characterized by comprising a metal substrate (col. 2, lines 5-6, steel plates, col. 3, line 7 and col. 3, lines 20-22 metal substrate layers) and having a microchannel portion on one surface thereon (Fig. 1, b, b', c and c'). The reference discloses that a catalyst can be placed on the microchannel portion of the substrate (col. 7, line 12 and col. 7, line 24). Thies discloses a cover member (Fig. 4, a, c, layer 2

and col. 6, line 46-49). Furthermore, Thies teaches that steel, copper or aluminum can be used as a substrate (metal layer, col. 6, line 21 or col. 6, line 21 or 37). Thies also teaches the formation of a metal oxide layer by anodically oxidizing the metal substrate (col. 7, lines 18-20, where the substrate is aluminum and the aluminum is oxidized with an acid). It would have been obvious to one of ordinary skill in the art at the time of the invention to apply the aluminum substrate, as taught by Thies, to the microreactor, as taught by Schuppich because to substitute one known element with high thermal conductivity for another known element with high thermal conductivity used to perform the same function of conducting heat would yield predictable results and therefore be obvious. Furthermore, it would have been obvious to one of ordinary skill in the art at the time of the invention to oxidize the substrate, as taught by Thies, with the microcreator, as taught by Schuppich because oxide layers can carry catalysts and facilitate a composition's reaction with such catalyst.

With Regard to Claim 4, Thies teaches that the metal oxide film is provided in said microchannel portion (col. 7, lines 17-27).

Claims 1, 2, 3, 4, 5, 6, 7, 8, 18, 23, 30, 31, 33, 34, 35, 53, 54 and 57 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kearl (6828055) and further in view of Bae (2002/0169077). Kearl teaches a microreactor that generates hydrogen gas (col. 8, lines 5-6 and 17, catalyst can be used to accelerate the conversion of hydrocarbons and alcohols to hydrogen), comprising a metal substrate (col. 7, lines 34-35, coated with

a precious metal), having a microchannel portion on one surface thereof (Fig. 1), a heater provided on the other surface of said metal substrate (Fig. 2B, 30 and 32 anode and cathode, which generate heat Fig. 2B, 24 and 26 are under substrate and claim 11, second face adopted to contact a cathode of a second fuel cell and Claim 16, resistive element adopted to heat the substrate, Fig. 2B, 14, microchannel, 16, back of substrate col. 12, lines 17-18, Fig. 2B, 30 and 32 are electrodes that heat substrate). Between the metal substrate and the heater (electrode) is a thin film insulating layer (col. 10, line 30, resistive element that may be a thin film resistive element), a catalyst supported on said micrchannel portion (col. 9, lines 55-56, catalyst is coated in microchannels, Fig. 7, 5 and Fig.12, 50), a cover member joined to said metal substrate so as to cover said microchannel portion (Fig. 2A, microchannels layered on top of one another so that the backs of each microchannel is the cover member and Fig. 2A, 66 is another cover member). Finally, Kearl teaches an inlet and an outlet (Fig. 8, Fig. 7, 46, 50) which are both capable of supplying feed material in and gas out. Kearl does not teach forming a metal oxide film on an inner wall surface of said flow path however. Bae teaches a microreactor that has microchannels and a catalyst layer. Bae further discloses forming a metal oxide film on an inner wall surface of said flow path (para. 0032, use of an oxidizable metal substrate such as nickel, copper, iron or cobalt, with an oxide ion conductor). It would have been obvious to one of ordinary skill in the art at the time of the invention to use a metal substrate, as taught by Bae, to the microreactor, as taught by Kearl because copper has a higher thermal conductivity than platinum.[1] Therefore, it

[1] Sanchez (2008/0142036), paragraph 0055.

would take less heat and energy for the substrate to conduct copper is much more inexpensive than platinum. With regard to the substrate being oxidized, it is known that a metal substrate in a fuel cell is prone to oxidation over time and heat, and therefore it is also inherent that the substrate would be oxidized.

Regarding Claim 2, Kearl teaches use of an aluminum substrate or stainless steel (col. 12, lines 24-27)

Regarding Claim 3, Kearl teaches a metal oxide film (col. 8, line 24 and col. 10, lines 45-50), but does not teach that the metal oxide film is formed by anodically oxidizing the metal substrate. Bae teaches use of an oxidizable metal substrate (copper, nickel, iron or cobalt, para. 0032) that sits on an oxide ion conductor. It would have been obvious to one of ordinary skill in the art at the time of the invention to use a metal substrate, as taught by Bae, to the microreactor, as taught by Kearl because copper has a higher thermal conductivity than platinum.[2] Therefore, it would take less heat and energy for the substrate to conduct and copper is much more inexpensive than platinum. Furthermore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have oxidized the substrates since oxide layers increase the hydrogen production of the channel (Bae, para. 0032, H2 yeld ranges from 34-60% when using the oxide layers, to 30% when using just a catalyst).

[2] Sanchez (2008/0142036), paragraph 0055.

Regarding Claim 4, a metal oxide film is also provided in said microchannel portion (col. 8, lines 1-7 and col. 8, line 24, zinc oxide).

Regarding Claim 5, Kearl teaches aluminum (col. 12, lines 24-27).

Regarding Claim 6, Kearl teaches use of a membrane in between the substrate and the heater so as to cover said heater (col. 10, lines 30-31, resistive element which covers said heater, while exposing portions of the electrode). Kearl does not specifically teach that only the electrodes are exposed, however, it would have been obvious to one of ordinary skill in the art at the time of the invention that exposure of the electrodes would reduce gas or water build up outside the fluid channels of the reactor.

Regarding Claim 7, please refer to the rejection for Claim 1 above.

Regarding Claim 8, please refer to the rejection for Claim 1 above.

Regarding Claim 18, please refer to the rejection for Claim 1 above.

Regarding Claim 23, Kearl teaches that between the metal substrate and the heater (electrode) is a thin film insulating layer (col. 10, line 30, resistive element that may be a thin film resistive element).

Regarding Claim 30, Kearl teaches a surface processing step of forming a metal oxide film on an inner wall surface of said flow path (col. 12, lines 51-57) and a catalyst applying step of applying a catalyst to the inner wall surface of said flow path via said metal oxide film (col. 12, lines 39-46, nickel is a catalyst in col. 8, line 20).

Regarding Claim 31, please refer to the rejection for Claim 30 above.

Regarding Claim 33, Kearl teaches that the microchannels are U-shaped or semi-circular (Fig. 8).

Regarding Claim 34, Kearl teaches coating the metal substrate with a catalyst using different methods such as spin coating, dip coating or dry film laminating (col.12, line 57), but does not specifically teach that the catalyst is dried in the microchannels. Bae teaches a microchannel with flow channels (para. 0005), where the slurry of catalyst is allowed to dry on the susbstrate (para. 0012, para. 0026 using the tape casting method and para. 0027).

Regarding Claim 35, Kearl teaches that catalyst can be applied using spin casting (para. 0012). Bae further teaches that the catalyst can be applied using spin coating (col. 12, line 57).

Regarding Claim 53, please refer to the rejection for Claim 30 above.

Regarding Claim 54, please refer to the rejection for Claim 30 above.

Regarding Claim 57, please refer to the rejection for Claim 30 above.

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over as being unpatentable over Kearl (6828055) and Bae (2002/0169077) as applied to Claim 30, and further in view of Lambert (5139648). Kearl and Bae both teach a microreactor that generates hydrogen gas (col. 8, lines 5-6 and 17, catalyst can be used to accelerate the conversion of hydrocarbons and alcohols to hydrogen), comprising a metal substrate (col. 7, lines 34-35, coated with a precious metal), having a microchannel portion on one surface thereof (Fig. 1), a heater provided on the other surface of said metal substrate (Fig. 2B, 30 and 32 anode and cathode, which generate heat Fig. 2B, 24 and 26 are under substrate and claim 11), but do not teach use of boehmite. Kearl does disclose a surface processing step of forming a metal oxide film on an inner wall surface of said flow path (col. 12, lines 51-57) and a catalyst applying step of applying a catalyst to the inner wall surface of said flow path via said metal oxide film (col. 12, lines 39-46, nickel is a catalyst in col. 8, line 20). Moreover, Bae teaches use of alumina (para. 0032, or aluminum oxide). Boehmite is aluminum oxide hydroxide, or AlO(OH). Lambert teaches that boehmite can be used instead of alumina (para. 0081). It would have been obvious to one of ordinary skill in the art at the time of

the invention to use boehmite, as taught by Lambert, with the microreactor, as taught by Kearl and Bae because Lambert teaches that boehmite could be used instead of aluminum oxide and that they are potential substitutes of one another. It would further have been obvious to one of ordinary skill in the art at the time of the invention that the alumina would likely become further oxidized under the heated conditions of the microreactor, hydrogen gas being generated and oxygen ions, so that a hydroxyl group would be added to the oxidized alumina.

Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over as being unpatentable over Kearl (6828055) and Bae (2002/0169077) as applied to Claim 30, and further in view of Wang (2003/0116503). Kearl and Bae both teach a microreactor that generates hydrogen gas (col. 8, lines 5-6 and 17, catalyst can be used to accelerate the conversion of hydrocarbons and alcohols to hydrogen), comprising a metal substrate (col. 7, lines 34-35, coated with a precious metal), having a microchannel portion on one surface thereof (Fig. 1), a heater provided on the other surface of said metal substrate (Fig. 2B, 30 and 32 anode and cathode, which generate heat Fig. 2B, 24 and 26 are under substrate and claim 11), but do not teach use of boehmite. Wang teaches a microreactor with channels, a metal substrate and a catalyst. Wang further teaches the use of alumina/alumina oxide layer (para. 0046, and 0041). Wang does not specifically teach use of boehmite, however, it would have been obvious to one of ordinary skill in the art at the time of the invention that oxidation of the

alumina catalyst in addition to heat, hydrogen and oxygen in the system would result in further oxidation of the alumina, resulting in boehmite.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHENG HAN whose telephone number is (571)270-5823. The examiner can normally be reached on Monday-Thursday, 7:30-5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jennifer McNeil can be reached on 571 272-1540. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Sheng Han
Examiner
Art Unit 4162

SH

/Jennifer McNeil/
Supervisory Patent Examiner, Art Unit 4162